

New Genera of Angarosphecinae: *Cretosphecium* from Early Cretaceous of Mongolia and *Eosphecium* from Early Eocene of Canada (Hymenoptera: Sphecidae)

WOJCIECH J. PULAWSKI, ALEXANDR P. RASNITSYN, DENIS J. BROTHERS, AND
S. BRUCE ARCHIBALD

(WJP) Department of Entomology, California Academy of Sciences, Golden Gate Park,
San Francisco, California 94118, USA; e-mail: wpulawski@calacademy.org;

(APR) Paleontological Institute, Russian Academy of Sciences, Moscow 117647, Russia;
e-mail: rasna@glasnet.ru;

(DJB) School of Botany and Zoology, University of Natal, Pietermaritzburg, Private Bag X01,
Scottsville 3209, South Africa; e-mail: brothers@zoology.unp.ac.za;

(SBA) Department of Biological Sciences, Simon Fraser University,
Burnaby, British Columbia V5A 1S6, Canada*

Abstract.—The new genus *Cretosphecium* Pulawski and Rasnitsyn is described for two Early Cretaceous species from Mongolia: *C. lobatum* Pulawski and Rasnitsyn (type species) and *C. triste* Pulawski and Rasnitsyn. *Eosphecium* Pulawski and Rasnitsyn is described to include only the new species *E. naumanni* Brothers and Archibald from the Early Eocene of Canada. *Eosphecium*, tentatively assigned to Angarosphecinae Rasnitsyn, 1975, may represent the first Cenozoic record for the subfamily, known heretofore only from Early Cretaceous deposits.

Species of Angarosphecinae Rasnitsyn, 1975 (= Baissodinae Rasnitsyn, 1975) are early sphecid wasps that lack synapomorphies of the extant subfamilies. Only a small fraction of the available material has been described so far (Rasnitsyn 1975; Rasnitsyn et al. 1998, 1999), and three additional fossils that we attribute to this subfamily are described here. These specimens are characterized by a unique wing venation, found in no other sphecids, either fossil or extant; and one shows pronotal lobes, a unique synapomorphy of Apoidea. Two are from the Early Cretaceous, and the third is from the Early Eocene, the first record from the Cenozoic Era for the subfamily. Until now, Angarosphecinae (including much undescribed material housed at the Paleontological In-

stitute, Russian Academy of Sciences) were known exclusively from the Early Cretaceous.

Morphological terminology used here deviates from that of Brothers (1975) and Bohart and Menke (1976) in several ways and is as in Rasnitsyn et al. (1999). The following structures, variously termed in the literature, are here defined or redefined for the sake of clarity and convenience:

- adlateral line: parapsidal line of Bohart and Menke (1976); we prefer the term coined by Budrys and Kazenas (1992) as it is more informative (self-explanatory and analogous to the admedian line) and also because the term parapsidal line is used by many authors to designate the structure that Bohart and Menke and most other hymenopterists call notaulus;
- interpostgenal suture: line of fusion of the postgenae, extending from the oral cavity to the occipital foramen;

* Current address: Museum of Comparative Zoology,
26 Oxford Street, Cambridge, Massachusetts 02138;
e-mail: barchibald@oeb.harvard.edu

- metasoma: abdomen excluding the propodeum (gaster of Bohart and Menke 1976);
- postgena: area between hypostomal carina and occipital foramen;
- spiracular lobe (Rasnitsyn 1988): pronotal lobe of Bohart and Menke (1976);
- costal space: cell C of Brothers (1975), costal cell of Bohart and Menke (1976);
- cell 1 + 2r: cell SC + R of Brothers (1975), submarginal cell I of Bohart and Menke (1976);
- cell 3r: cell R of Brothers (1975), marginal cell of Bohart and Menke (1976);
- cells 2rm and 3rm: cells 1S and 2S of Brothers (1975), submarginal cells II and III of Bohart and Menke (1976);
- cells 1m-cu and 2m-cu: cells S + M and 1M of Brothers (1975), discoidal cells I and II of Bohart and Menke (1976);
- cell 2cua: 1Cu of Brothers (1975), subdiscoidal cell of Bohart and Menke (1976);
- veins 2r-m and 3r-m: distal margins of cells 2rm and 3rm, respectively (as in Richards 1977, and Gauld and Bolton 1988), corresponding to crossveins 1s-m and 2s-m of Brothers (1975), and 1r-m and 2r-m of Bohart and Menke (1976); we consider the true 1r-m to be present only in primitive Symphyta such as the xyelid genus *Pleuroneura* Konow or *Xyela lata* D. Smith.
- veinlet 1r-rs: partial vein within cell 1 + 2r, originally separating cells 1r and 2r; called 1r by Bohart and Menke (1976).
- crossvein 2r-rs: vein separating cells 1 + 2r and 3r, called r-s by Brothers (1975) and 2r by Bohart and Menke (1976).

Figs. 1 and 2 are by APR and Fig. 3 is by DJB.

***Cretosphēcium* Pulawski and Rasnitsyn,
new genus
(Figs. 1, 2)**

Derivation of name.—*Cretosphēcium*, from the Latin word *creta* (chalk) and the Greek word *sphēcion* (little wasp); with reference

to its occurrence in the Cretaceous Period. Gender neuter.

Diagnosis.—*Cretosphēcium* has an unusually long cell 2rm whose posterior margin is longer than that of cell 1 + 2r, veins 1m-cu and 2m-cu are received by cells 2rm and 3rm, respectively, and cell 3r is truncate apically. A similar venation is found in *Eosphēcium*. In *Cretosphēcium*, however, vein 2r-rs is less than the height of pterostigma, cell 3r receives vein 3r-m next to the apical truncation, vein 1m-cu joins cell 2rm at the cell's midlength, cell 2rm is less than 3 times as long as high, and cells 2cua, 2m-cu, and 1m-cu are about equal in height. In *Eosphēcium*, vein 2r-rs is about equal to the height of pterostigma, vein 3r-m is markedly distant from the apex of cell 3r, vein 1m-cu joins cell 2rm before the cell's midlength, cell 2rm is almost 5 times as long as high, and cells 2cua and 2m-cu are about twice as high as cell 1m-cu.

Description.—The following complements the above characteristics. Pronotal hindmargin angulate dorsolaterally adjacent to spiracular lobe. Scutum: notaulus complete, extending from hindmargin to foremargin; adlateral line extending from hindmargin almost to foremargin. Forewing: vein 2r-m oblique, sinuous or straight, vein 3r-m oblique and sinuous (in *C. lobatum*, not preserved in *C. triste*), its anterior end insignificantly closer to wing margin than to apex of cell 3r; vein cu-a postfurcal. Hindwing (preserved only in *C. lobatum*): cu-a postfurcal, angled with first abscissa of Cu. Metasoma sessile.

Taxonomic position.—The presence of a spiracular lobe (visible in *C. lobatum*) demonstrates that *Cretosphēcium* is a member of Apoidea. The elongate notaulus that reaches the mesoscutal hindmargin is an ancestral character not found in any of the extant apoid genera but is typical of the subfamily Angarosphēcinae.

Type species.—*Cretosphēcium lobatum* Pulawski and Rasnitsyn, new species.

Composition.—Two species from the Early Cretaceous of Mongolia.

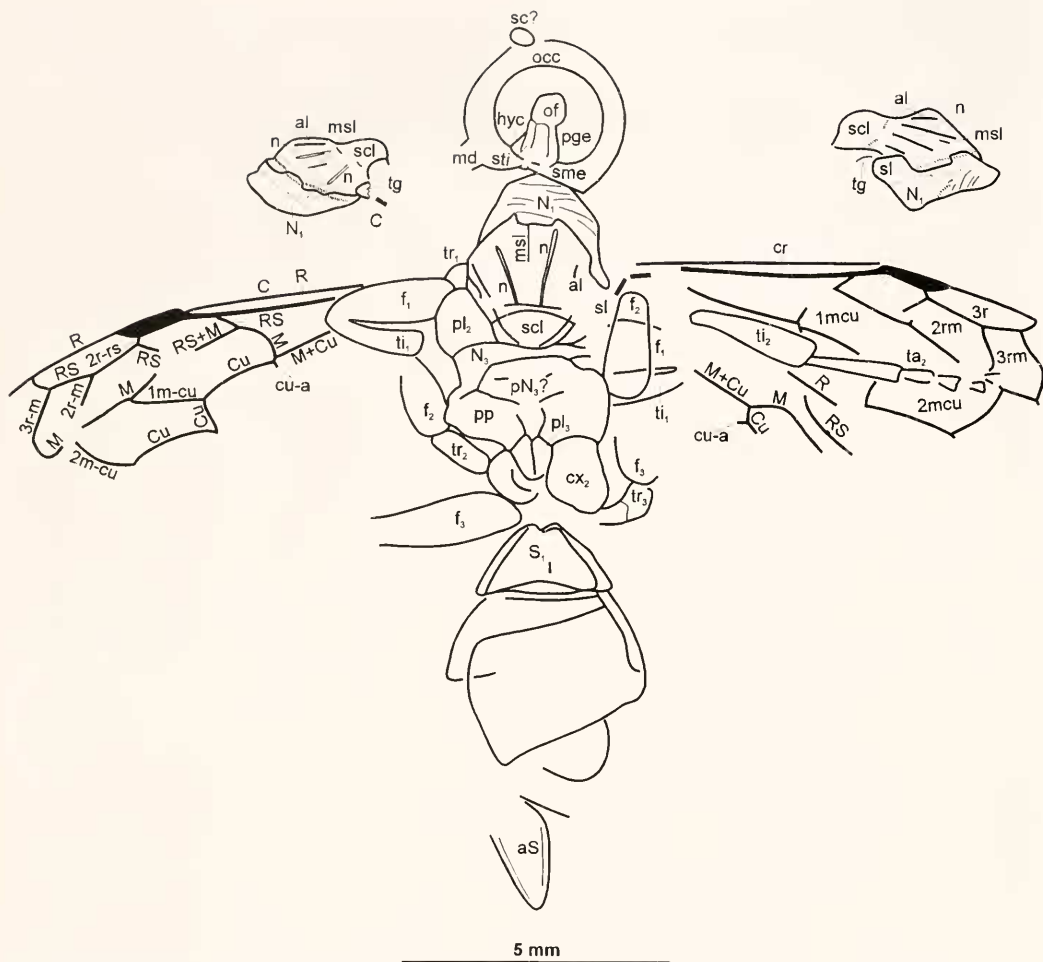


Fig. 1. *Cretosphēcium lobatum* Pulawski and Rasnitsyn, new species. Upper left and right: thoracic dorsum in two aspects; al: adlateral line; aS: apical metasomal sternum; cr: costal; cx: coxa; f: femur; hyc: hypostomal carina; md: mandible; msl: median mesoscutal line; n: notaulus; N₁: pronotum; N₂: metanotum; occ: occipital carina; of: occipital foramen; pge: postgena; pl₂, pl₃: meso- and metathoracic venters; pN₃: metapostnotum (= propodeal enclosure); pp: propodeum; S₁: metasomal sternum I; sc: scape; scl: scutellum; sl: spiracular lobe; sme: submentum; sti: stipes; ta: tarsus; tg: tegula; ti: tibia; tr: trochanter. Labels for veins and cells are conventional or as explained in text.

Relationship of included species.—We treat the two specimens described below as congeneric because of their similar wing venation and in spite of their morphological differences (presence or absence of the interpostgenal bridge, form of the metathoracic venter). These differences could be regarded as generic, but we prefer to base our classification solely on the wing venation, admittedly perhaps creating artificial assemblages of unrelated taxa. This, how-

ever, appears to be the most realistic approach, given that the body structures are unknown in the majority of fossils.

Cretosphēcium lobatum Pulawski and Rasnitsyn, new species
(Fig. 1)

Derivation of name.—*Lobatum*, a Latin neuter adjective meaning lobed; with reference to the spiracular lobes which can be clearly identified in the holotype.

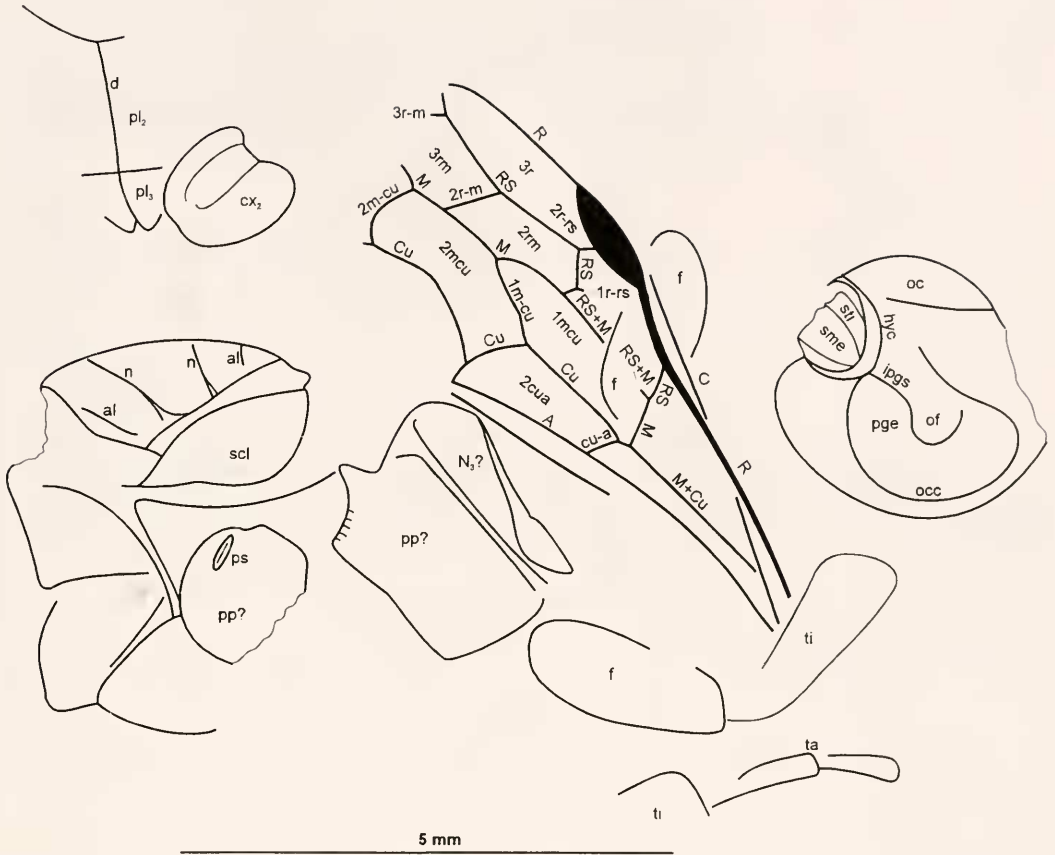


Fig. 2. *Cretosphecium triste* Pulawski and Rasnitsyn, new species; d: discrimen (interpleural suture); ipgs: interpostgenal suture; oc: eye; ps: propodeal spiracle. Other abbreviations as in Fig. 1.

Diagnosis.—Larger than *C. triste* (e.g., length of forewing about 9.0 mm rather than about 6.8 mm), vein 2r-rs emerging at about two-thirds pterostigmal length, vein 2r-m sinuous, and foremargin of cell 3r-m shorter than height of cell.

Description.—Sex unknown. No coarse sculpture recognizable except pronotum transversely ridged. Head nearly circular, occipital carina complete, postgenae widely separated, gap between them obscured by bases of maxillae and labium. Mesoscutum with rudimentary median line. Metathoracic venter forming a subtriangular elevation between hindcoxae. Forewing: vein 2r-rs emerging at about two thirds of pterostigmal length; vein 2r-m sinuous, its fore end closer to 3r-m than to

2r-rs; vein 3r-m oblique, sinuous; maximum width of cell 3r-m markedly less than its basal height. Length of midtrochanter more than twice width. Midbasitarsus longer than midtarsomeres II-IV combined, midtarsomere IV longer than wide. Metasomal segment I subtriangular, wider than long, hindmargin of sternum I shallowly emarginate. Sternum II longer and wider than I, its anterior margin straight. Apical sternum subtriangular, carinate laterally. Body length as preserved 16.2 mm, forewing about 9.0 mm long, head width 3.0 mm. Body dark (color unknown for missing parts: antennal flagellum, hindtibiae and tarsi), but the following are distinctly paler: midtarsus (except basitarsus base) and wing veins including pterostigma.

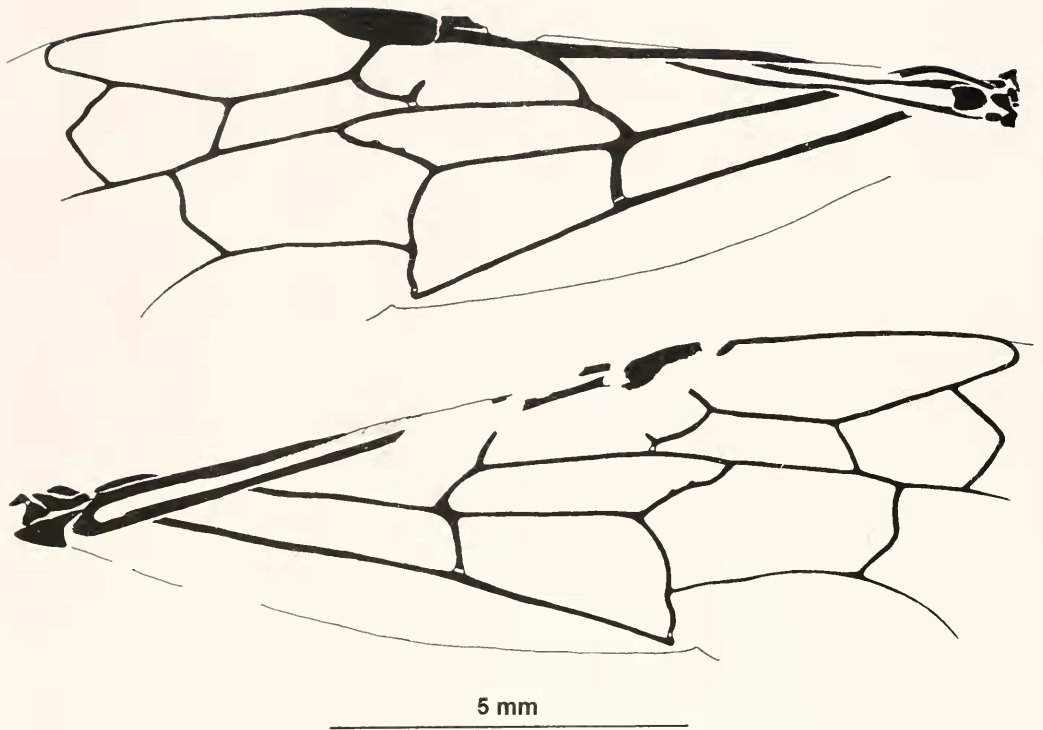


Fig. 3. *Eosphecium naumanni* Brothers and Archibald, new species.

Type material.—Holotype: Mongolia, Bayanhongor Aymag: Bon Tsagan, 5–8 km north of Bon Tsagan Nuur (= Bon Tsagan Lake); Early Cretaceous, impressed in marl of the Khurilt rock unit, Bon Tsagan Series (Sinitza 1993), possibly of Aptian age (Ponomarenko 1990). Deposited in the Paleontological Institute, Russian Academy of Sciences, Moscow, Russia (catalog number 3559/4533).

Cretosphecium triste Pulawski and Rasnitsyn, new species
(Fig. 2)

Derivation of name.—*Triste*, Latin neuter adjective meaning sad; with reference to the specimen's poor preservation.

Diagnosis.—Smaller than *C. lobatum* (e.g., length of forewing about 6.8 mm rather than about 9.0 mm), vein 2r-rs emerging at pterostigmal midlength, vein

2r-m straight, and foremargin of cell 3rm longer than basal height of the cell.

Description.—Sex unknown. Head nearly circular, postgenae broadly contacting mesally, occipital carina complete and meeting hypostomal carina near midline of head. Scutum with no median line. Apex of metapleural venter with triangular emargination. Propodeal spiracle long, narrow. Forewing: vein 2r-rs emerging at pterostigmal midlength; vein 2r-m straight, its fore end equidistant from 2r-rs and 3r-m. Legs appearing thicker than in *C. lobatum*. Original color probably not preserved (entire specimen uniformly light).

Type material.—Holotype: Mongolia: Bayanhongor Aymag: Bon-Tsagan (other data as under *Cretosphecium lobatum* above). Deposited in the Paleontological Institute, Russian Academy of Sciences,

Moscow, Russia (catalog number 3559/694).

***Eosphecium* Pulawski and Rasnitsyn,
new genus
(Fig. 3)**

Derivation of name.—*Eosphecium*, from the Greek words *eos* (dawn, morning, early) and *sphékion* (little wasp); with reference to the Eocene age of the specimen. Gender neuter.

Type species.—*Eosphecium naumannii* Brothers and Archibald, new species.

Diagnosis.—Like *Cretosphecium*, *Eosphecium* is characterized by an elongate cell 2r_m (the length of its posterior margin is approximately equal to that of cell 1 + 2r), veins 1m-cu and 2m-cu are received by cells 2r_m and 3r_m, respectively, and cell 3r is truncate apically. Unlike in that genus, the length of vein 2r-rs in *Eosphecium* about equals the width of the pterostigma; the anterior end of vein 3r-m is removed from the apex of cell 3r by more than the height of cell 2r_m; veins RS + M and M (= posterior margins of cells 1 + 2r, 2r_m, and 3r_m) form an almost straight line (although *Cretosphecium lobatum* approaches this condition); vein 1m-cu joins cell 2r_m before the cell's midlength; cell 2r_m is almost 5 times as long as high (less than 3 times in *Cretosphecium*); and cells 2c_{ua} and 2m_{cu} are about twice as high as cell 1m_{cu} (about equal in *Cretosphecium*).

Taxonomic position.—In the absence of other evidence, we assign *Eosphecium* to Angarosphecinae based solely on the forewing venation pattern that resembles that of *Cretosphecium*. We also consider the above differences and the major difference in stratigraphic age sufficient to warrant its description a separate genus.

***Eosphecium naumannii* Brothers and
Archibald, new species
(Fig. 3)**

Derivation of name.—Named after Dr. Ken Naumann who collected the specimen.

Description.—The following characters are complementary to the generic diagnosis above: vein 2r-rs emerging at pterostigmal midlength; vein 2r-m straight, its fore end about equidistant from 2r-rs and 3r-m; vein 3r-m markedly angled near midlength; vein cu-a slightly postfurcal; vein Cu₂ sinuous. Costal space densely setose towards apex and deeply pigmented (evident in counterpart), remainder of wing pale; veins dark. Forewing length about 14.2 mm (thus considerably larger than both species of *Cretosphecium*).

Type material.—Holotype (forewing only): Canada, British Columbia: Quilchena, 50°07'40.3"N, 120°30'34.7"W; Early Eocene: Coldwater beds of the Kamloops Group, 52–54 mya (Mathewes and Villeneuve in prep.). Deposited in the Department of Biology, Simon Fraser University, Burnaby, British Columbia, Canada, catalog number Q-0423a (part) and Q-0423b (counterpart).

ACKNOWLEDGMENTS

We sincerely thank Dr. Ken Naumann (Langara College, Vancouver) who donated the specimen of *Eosphecium naumannii* to Simon Fraser University and made it available for study. Financial assistance to DJB from the University of Natal Research Committee is acknowledged with gratitude. Comments by an anonymous reviewer helped improve the manuscript.

LITERATURE CITED

- Bohart, R. M., and A. S. Menke. 1976. *Sphécid Wasps of the World. A generic revision*. University of California Press, Berkeley, Los Angeles, London. 1 color plate, IX + 695 pp.
- Brothers, D. J. 1975. Phylogeny and classification of the aculeate Hymenoptera, with special reference to Mutillidae. *The University of Kansas Science Bulletin* 50: 483–648.
- Budrys, E. R., and V. L. Kazenas. 1992. Novye vidy royushchikh os roda *Diodontus* (Hymenoptera, Sphecidae)—New species of the genus *Diodontus* (Hymenoptera, Sphecidae). *Zoologicheskii Zhurnal* 71 (8): 24–31. English translation: 1993. New species of digger wasps of the genus *Diodontus*. *Entomological Review* 72: 114–121.
- Gauld, I., and B. Bolton. 1988. *The Hymenoptera*. British Museum (Natural History) and Oxford University Press, Oxford, 332 pp.

- Ponomarenko, A. G. 1990. Nasekomyie i stratigrafiya nizhnego mela Mongolii (= Insects and the Lower Cretaceous stratigraphy of Mongolia), p. 103-108 in Krassilov V.A. (editor). *Kontinental'nyi mel SSSR. Materialy Soveshchaniya Sovetskoy Rabochey Gruppy Proekta N° 245 "Korrelatsiya nemorsksogo mela" Mezhdunarodnoy Programmy Geologicheskoy Korrelatsyi* (= Non-marine Cretaceous of the USSR. The Submission from the Conference of the Soviet Working Group of the IGCP Project 245), Vladivostok, 1988. Dal'nevostochnyi Otdel Akademii Nauk SSSR, Vladivostok. 226 pp.
- Rasnitsyn, A. P. 1975. Vysshye pereponchatokrylye mezozoya—Hymenoptera Apocrita of Mesozoic. *Akademiya Nauk SSSR. Trudy Paleontologicheskogo Instituta* (= Academy of Sciences of the USSR. Transactions of the Palaeontological Institute) 147: 1-133, 1-VIII.
- Rasnitsyn, A. P. 1988. An outline of evolution of the hymenopterous insects (order Vespida). *Oriental Insects* 22: 115-145.
- Rasnitsyn, A. P., E. A. Jarzembowski, and A. J. Ross. 1998. Wasps (Insecta: Vespida = Hymenoptera) from the Purbeck and Wealden Lower Cretaceous of Southern England and their biostratigraphical and paleoenvironmental significance. *Cretaceous Research* 19: 329-391.
- Rasnitsyn, A. P., W. J. Pulawski, and X. Martínez-Delclós. 1999. Cretaceous digger wasps of the new genus *Bestiola* Pulawski and Rasnitsyn (Hymenoptera: Sphecidae, Angarosphecinae). *Journal of Hymenoptera Research* 8: 23-34.
- Richards, O. W. 1977. *Hymenoptera. Introduction and keys to families, second edition. Handbooks for the identification of British Insects*, Vol. VI, Part 1. Royal Entomological Society of London, London. 104 pp.
- Sinitza, S. M. 1993. Yura i nizhnii mel Tsentral'noy Mongolii (= Jurassic and Lower Cretaceous of Central Mongolia). *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii* [= Transactions of the Joint Soviet-Mongolian Paleontological Expedition]. No. 42: 1-239 pp.